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## **New information on the Snow Partridge *Lerwa lerwa* (Hodgson 1833) and its systematic position**

*by R. L. Potapov*

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The Snow Partridge *Lerwa lerwa* is one of the most poorly known species of the subfamily *Perdicinae*, if not the whole family *Phasianidae*. Since its description for science in 1833 there have been only three publications on the species, two of which were short taxonomic notes proposing new subspecies. The only publication on its ecology appeared as recently as 1992 (Li & Lu 1992). The only other information is limited to notes on distribution and habitat collected during general avifaunal surveys. There are a few references contained in regional bird faunas (Ali 1962, Ali & Ripley 1969, Vaurie 1972, Roberts 1991) and the most comprehensive information on the distribution and the natural history of the Snow Partridge to date is Baker (1935). The information and even complete sentences from this publication have been repeated in all subsequent accounts of the species.

Whilst its remote distribution may account for the scarcity of information on ecology and complete lack of behavioural data, it is rather surprising that there has been no museum study to investigate its systematic relationships more clearly. This monotypic genus has always been listed with three or four genera of Palearctic mountain partridges (*Ammoperdix*, *Alectoris*, *Tetraogallus* and *Tetraophasis*) at the start of all taxonomic lists of the subfamily *Perdicinae*, despite the absence of any

important similarities with them (Ogilvie-Grant 1893, Peters 1934). This classification was probably based on each author's intuition rather than any systematic analysis and provides no supporting data for this taxonomic sequence.

Here, I use data from museum specimens and the literature to make proposals about the evolutionary history of the species and thus to assess the validity of the traditional taxonomic grouping. In turn I considered habitats and geographical distribution, plumage colouration, wing shape and moult, and adaptations to the cold.

## Geographic distribution and habitats

Examination of literature and museum collections provides the following north-western confirmed localities of the distribution of Snow Partridge: Safed-Koh mountains on the Afghanistan-Pakistan border; Nanga Parbat surroundings and sources of the Hunza River in eastern Pakistan (Baker 1935, Roberts 1991). This species does not penetrate to the Hindu Kush range or to the Pamirs, where the subalpine and alpine zones are more arid.

The most north-easterly localities are the northern ridges of the Sino Tibetan mountains at the right bank of Upper Huang (Yellow) River. The species does not penetrate to the north because of the more arid climatic conditions. These distributional affinities suggest that the Snow Partridge has a southern origin: the degree of humidity in Central Asia is an important factor limiting distribution of plants and animals. For example, the range of the Himalayan Snowcock *Tetraogallus himalayensis*, a species adapted to an arid climate, is restricted by a sharp increase in humidity in the subalpine and alpine zones east from Nepal (Potapov 1966).

The Snow Partridge's preferred habitats lie in subalpine and partly alpine zones above the treeline. They are slopes covered by grass, moss, rhododendron and other shrubs, lichen-bearing rocks and stone fields with snow patches. There appears to be overlap of habitats with the Tibetan Snowcock *Tetraogallus tibetanus*, the dominant species varying from place to place. Otherwise, Snow Partridges avoid the snowcocks' main habitat—the barren slopes above the treeline with scarce vegetation. The importance of slope exposure for the Snow Partridges is not known and it may be that in southern latitudes differences between southern and northern slope exposure is not so important as in the north. The main climatic feature of the habitats of the Snow Partridge throughout its range is high humidity, with most precipitation in summer and little snow during the winter. Most of the foraging habitats are snow-free, avoiding the need for altitudinal migrations. The only indication in the literature that Snow Partridges descend to lower altitudes during winters is that they are found at about 2,500 m above sea level during severe winters (Baker 1935).

The relationship between Snow Partridges and a humid climate explains the northern boundaries of its range. The subalpine and alpine belts circle the Tibetan Plateau with a break in the north. The humidity there is high enough because of the influence of summer monsoons, but these do not seriously affect the climatic conditions in the area north of the Karakorum in the west and the Sino-Tibetan mountains in the east (Fig. 1).

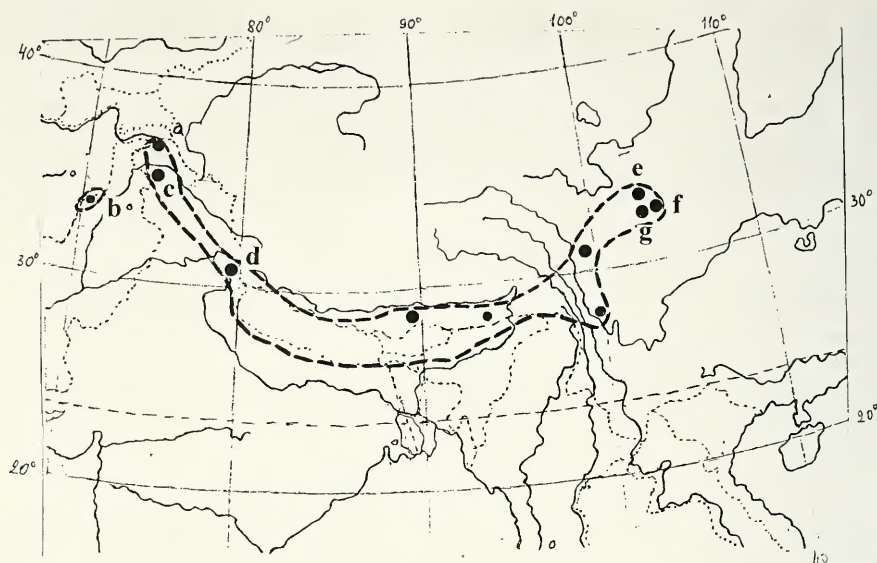


Figure 1. The range of the Snow Partridge, *Lerwa lerwa*. Known limits of distribution in the NW and NE are: (a) Upper Hundjerab Valley (Roberts 1991), 75°E, 37°N; (b) Parachinar (Baker 1934), 70°10'E, 34°05'N; (c) Nanga-Parbat surroundings (Baker, 1934), 74°40'E, 35°N; (d) Garhwal-Baratoli (Baker 1934), 79°E, 31°N; (e) Sigu district (Beresovski & Bianchi 1891), 103°30'E, 3°3'N; (f) Lungan-Fu district, 104°10'E, 32°30'N (coll. Zool. Institute Russian Ac. Sci., St. Petersburg); (g) Longmen Mountains, 103°30'-104°30'E and 31°30'-32°30'N (Li & Lu 1991). Other dots in China's territory—according to Li & Lu 1991.

## Plumage colouration

All *Ammoperdix*, *Alectoris* and *Tetraogallus* species have a very pale colouration, especially on the upperparts. This confers a highly cryptic effect in the open, semi-desert habitats that they all prefer. Some populations of snowcock species, however, possess darker upperpart colouration; these inhabit areas with darker substrates and higher humidity. Nevertheless, in all forms there is a complete absence of prominent stripes or spots in the colouration of the upperparts. The *Tetraophaps* species have the dusky grey-brown colouration with the same cryptic effect in the forest habitats that they prefer. In contrast, the upperparts of the Snow Partridge are very dark and are barred by narrow black and white stripes (Plate 2). This colour pattern is unique among the perdixine birds, although there are some species of South and South-east Asian partridges (e.g. Chinese Bamboo Partridge *Bambusicola thoracica*, Chestnut-bellied Partridge *Arborophila javanica*, Formosan Partridge *A. crudigularis*, and Hill Partridge *A. torqueola*) in which the upperparts are barred with black or dark stripes (excluding the head).

The underparts of the Snow Partridge are also very dark brown with white longitudinal stripes formed by white lateral patches on the dark brown feathers. Such





Plate 2. Colour pattern of some *Perdicinae* species: I. Upper view; (a) *Lerwa lerwa* (sexes alike), (b) See-see Partridge *Ammoperdix griseogularis*, male, (c) *A. griseogularis*, female, (d) Chukar, *Alectoris kakelik* (sexes alike), (e) Buff-throated Partridge, *Tetraophasis szechenyi* (sexes alike), (f) Himalayan Snowcock, *Tetraogallus himalayensis* (sexes alike). II. Side view in the same order.

colour patterns are common in some perdicine species and can be seen, for example, in some francolins (*Francolinus squamatus*, *F. nahani* and *F. jacksoni*). The Snow Partridge seems to prefer grassland habitats above the treeline and it tends to avoid large expanses of bare, open land. Its upperpart colouration appears to be a result of cryptic adaptation to the dark background of these habitats, with the striped plumage allowing the bird to blend among the grass stems. Its dark colouration suggests that its previous evolutionary development took place in warm, humid climatic conditions or is a recent adaptation to warm humid conditions and vegetation.

Another important feature of this species is the colouration of downy young. It is completely different from that of the *Anmoperdix–Alectoris–Tetraogallus* group, but is similar to the colouration of the downy young of the Blood Pheasant *Ithaginis* and, to a lesser degree, with the downy young of the *Arborophila* hill-partridges and the monals *Lophophorus*. In galliform birds, the colouration of the downy young has been used in phylogenetic analyses together with other features, and has been considered to have a useful but not decisive significance (Short 1967, Potapov 1985). The colouration of the young suggests that the Snow Partridge has a closer relationship with the South-east Asian phasianids rather than the *Anmoperdix–Alectoris–Tetraogallus* group. Snow Partridge show some resemblance in colouration to female Blood Pheasants, both being fully dark-brown with narrow black barring.

### Wing shape and moult

The shape of the wing's tip depends on the position of the longest primary in respect to the front edge of the wing. The closer the longest primary is to the front edge of the wing the more pointed the wing is; the more distant the longest primary is from the front edge of the wing, the rounder is the wing. Wing shape of the Snow Partridge is similar to that of the snowcocks *Tetraogallus*, in contrast with the more rounded wing tip of forest partridges (Fig. 2). This trait does not have any phylogenetic significance, as it is more influenced by ecology than evolutionary history. This type of wing shape is an adaptation to high-speed flight with a quick, horizontal take-off, in contrast to the slower flight and vertical take-off of forest partridges and pheasants. The large relative width of Snow Partridge wings (74–75% of wing length instead of 68–70% in snowcocks and rock partridges) indicates a significant capacity for gliding flight. As in snowcocks (Potapov 1992) the downhill gliding flight in high mountains could save a considerable amount of energy to Snow Partridges moving from one slope to another. I hope that further detailed observations will prove this hypothesis.

The moult of Snow Partridges is the same as in other partridges with one principal exception. The three outer juvenile primaries, that appear in chicks during the last stages of growth, are not replaced by adult primaries, like other juvenile primaries, till the following autumn (i.e. in their second year), as in snowcocks. This is most probably an adaptation to specific conditions in high mountains with very short periods suitable for the development of the young bird's wing. Such adaptations could have developed independently in snowcocks and Snow Partridges.

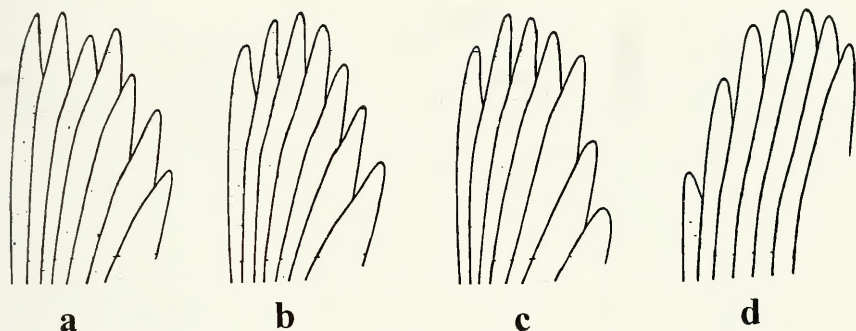


Figure 2. The top of the wing and position of the longest primaries in: (a) Snow Partridge *Lerwa lerwa*, subadult, (b) Snow Partridge *L. lerwa*, adult, (c) Tibetan Snowcock *Tetraogallus tibetanus*, adult, (d) Hill Partridge *Arborophila torqueola*, adult.

### Adaptations to the cold

Recent studies confirm that the Snow Partridge lives permanently at high elevations (3,500–5,000 m above sea level) (Li & Lu 1992). Even in summer there are some patches of snow in the main habitats and occasional snowfalls, and July is the only frost-free month. Winter mean air temperature varies between -10 and -25°C with a minimum of about -40°C. There are no data on the quality of winter plumage of the Snow Partridge or on winter body fat reserves. Nevertheless, specimens in collections provide good evidence of adaptation to the cold climate.

First, the Snow Partridge has the most feathered tarsi among all Phasianidae birds (Potapov 1985). On average 42% of tarsus length (up to 55% in some specimens) is feathered. This is more than in some tetraonid species such as the Chinese Grouse *Bonasa sewerzowi*. Even tarsi of recently hatched chicks are feathered (Meinertzhagen 1927). Second, feathers cover the nostrils around the operculum (the ceratinous lid covering the nostrils) as in monals *Lophophorus* sp., but is not atrophied as in tetraonid birds, in which the operculum is completely replaced by feathers (Potapov 1985).

Finally, the body mass of the Snow Partridge also shows adaptation to cold winters. The body mass, which exceeds 700 g at the age of 160–170 days (at the beginning of December) (Li & Lu 1992), is rather high for a bird with such body size (the wing length—185–205 mm). These data were obtained from birds reared in captivity, but it is evidence of the ability of this bird to accumulate fat deposits at the beginning of the winter. In comparison to some tetraonid birds with the same wing length (at the onset of winter) the Snow Partridge is much heavier. The Ruffed Grouse *Bonasa umbellus* has a wing length of about 190 mm and a mean body mass in autumn only of 660 g; the Rock Ptarmigan *Lagopus mutus* from the northern Ural mountains has a wing length of 187 mm and a body mass in autumn of about 500 g. It is well known that tetraonid birds significantly increase their body weight with the onset of winter (Potapov 1985). The Snow Partridge seems to do the same, accumulating fat deposits in the autumn.



## Discussion

The colour patterns of adult and downy young birds, distribution, and habitat selection suggest phylogenetic affinities of the Snow Partridge with the partridges of southern Asia, including those of the Himalayas. Inhabiting the marginal habitats along the Himalayan and South Tibetan mountains, the ancestral form of this species penetrated higher into the subalpine zones, where competition with other partridges was markedly less than in forest habitats of the foothills and lowlands. This process of penetration to the open habitats above the treeline reached a special intensity during the Pleistocene cold periods. The Wurmian glaciation (approximately 25,000 years BP) had probably a global influence and led to a marked reduction in forest vegetation, even in the tropics (Hamilton 1976, Shacleton 1977). In the mountains, the treeline descended significantly and the area of the open habitats above this line increased. Of course, similar processes took place in every cold epoch during the Pleistocene. Another important factor in the evolutionary history of the Snow Partridge is the uplift of the Himalayan and adjacent mountain systems. There is evidence that the uplift of the Tibetan Plateau and its surrounding mountain ridges intensified towards the end of Pliocene, but they attained sufficient altitude to develop a subalpine zone only in the early Pleistocene, nearly 1,000,000 years BP (Sinitzin 1962). This is long enough ago to allow the evolution of a new, very sophisticated and specialised species such as the Snow Partridge. In comparison, most species of grouse (Tetraonidae) are significantly younger and the recent species of the snowcocks *Tetraogallus* are probably no older than 50,000–80,000 years (Potapov 1985, 1992). Davison (1982), in his paper on the systematics of the hill partridges *Arborophila*, suggests that there was a series of four invasions southward from continental Asia to the Sunda subregion, between the middle and late Pleistocene. Based on an investigation of intrageneric relationships, Davison concluded that the species from progressively more recent invasions are found at increasingly lower altitudes. The most ancient intruders are Red-breasted Partridge *A. hyperythra*, Red-billed Partridge *A. rubrirostris* and *A. javanica*, which inhabit upper montane forests above 1,500 m in Borneo, Sumatra and Java respectively. Davison did not relate these invasions to periods of Pleistocene glaciation but mentioned that 'in the future it may be possible to correlate these four invasions with the timing of four interpluvial periods, the tropical manifestation of the Pleistocene glaciations'. In any case, the influence of Pleistocene glaciations on tropical regions is not in doubt (Hamilton 1976, Shacleton 1977).

The implications of this influence on the evolutionary history of partridges are considerable. Only events of such global scale might explain the existence of four groups of *Arborophila* in Sunda Islands, as well as the unique systematic and geographical position of the Snow Mountain Quail *Anurophasis monorhonyx* of New Guinea. This is a high altitude species that inhabits the open grasslands of mountain ridge tops at 3,100–4,000 m above sea level. Its ecology is currently unknown. In general, the upperpart colouration of the adult bird is similar to that of the Snow Partridge—sequences of light and black bars. In the Snow Mountain Quail

these stripes are less prominent and, moreover, are divided by a black line along the feather's stem. This similarity may be the result of convergence, in camouflage roles of patterns in grass habitats, and may have evolved in both species independently. The above analysis is far from complete, but it does indicate that the evolutionary history of the Snow Partridge reveals closer affinities to species further south than its current grouping with the palearctic mountain partridges suggests. In order to clarify these relationships, we need new data on the ecology of the Snow Partridge in the central and western parts of its distribution area. The one publication cited above (Li & Lu 1992) is based on investigations of this species' ecology near the north-eastern border of this area. Data are needed for comparative purposes on habitats, daily routine, courtship displays, population dynamics and especially on winter ecology. In addition, information on the coexistence of the Snow Partridge with other galliform birds, especially with *Tetraogallus* species, would further clarify these relationships.

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## **Re-evaluation of the House Finch subspecies *Carpodacus mexicanus roseipectus* from Oaxaca, Mexico**

*by Laurence C. Binford*

*Received 14 January 1999*

In his *Catalogue of the birds in the British Museum*, Sharpe (1888) described *Carpodacus roseipectus* based on two adult males from "Oaxaca, W. Mexico (A. Fenochio)" and one adult female from "Oaxaca, Nov. 1860 (A. Sallé)". Ridgway (1901) later reduced *roseipectus* to a subspecies of *Carpodacus mexicanus* (Müller). Moore (1939), in his detailed taxonomic revision, and Miller *et al.* (1957), in the most recent treatment of Mexican subspecies, also accepted *roseipectus*, the latter presumably on the advice of co-author Moore. Neither Ridgway (1901) nor Moore (1939), however, personally examined specimens of true *roseipectus* and, as a result, the subspecies has never been properly characterized.

In the mid 1960s, when T. R. Howell, R. A. Paynter, and A. L. Rand (Paynter 1968) were revising the Carduelinae for "Peters' Checklist", Howell (*in litt.*) asked me if I thought *roseipectus* was a valid race; I thought not, having seen specimens of both presumed *roseipectus* and typical *C. m. mexicanus* from the Oaxaca Valley. Howell (in Paynter 1968) therefore subsumed *roseipectus* in *C. m. mexicanus*.

Later, however, I learned that the specimens of nominate *mexicanus* supposedly from the Oaxaca Valley possessed untrustworthy data and almost certainly came from elsewhere. I therefore suggested (Binford 1989) that *roseipectus* should be re-evaluated and properly characterized in light of this knowledge. In this paper, I do so.

### **Data on Mario del Toro Avilés specimens**

All specimens of *C. m. mexicanus* supposedly from the Oaxaca Valley were collected by Mario del Toro Avilés and labelled "Mitla" (San Pablo Villa de Mitla of Binford 1989), a village 48 km east-southeast of Oaxaca City.

M. del Toro Avilés was a professional collector but was poorly versed in proper labelling techniques. In some cases his localities are clearly erroneous, suggesting